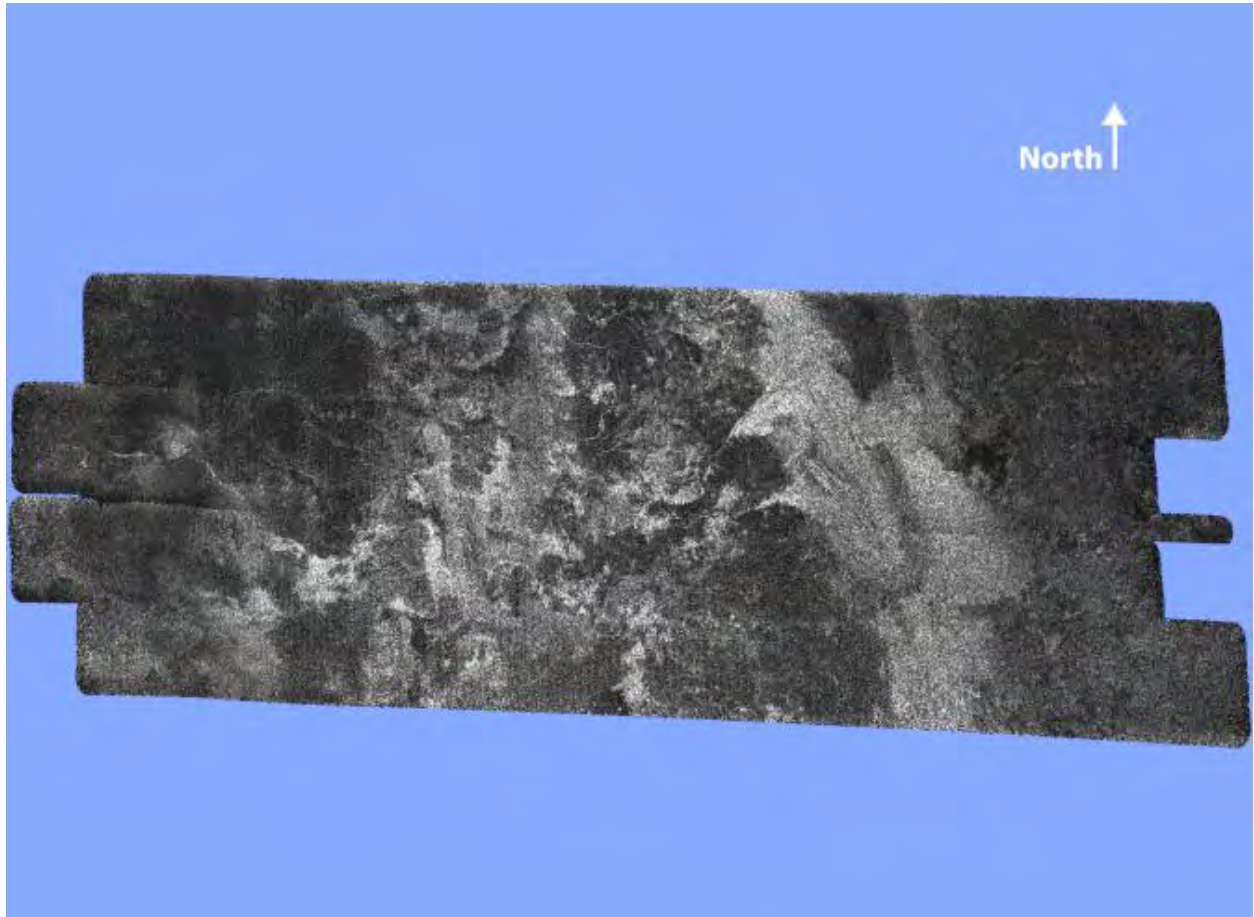


# C A S S I N I



## T I T A N    0 3 7 T I ( T 2 3 ) MISSION DESCRIPTION

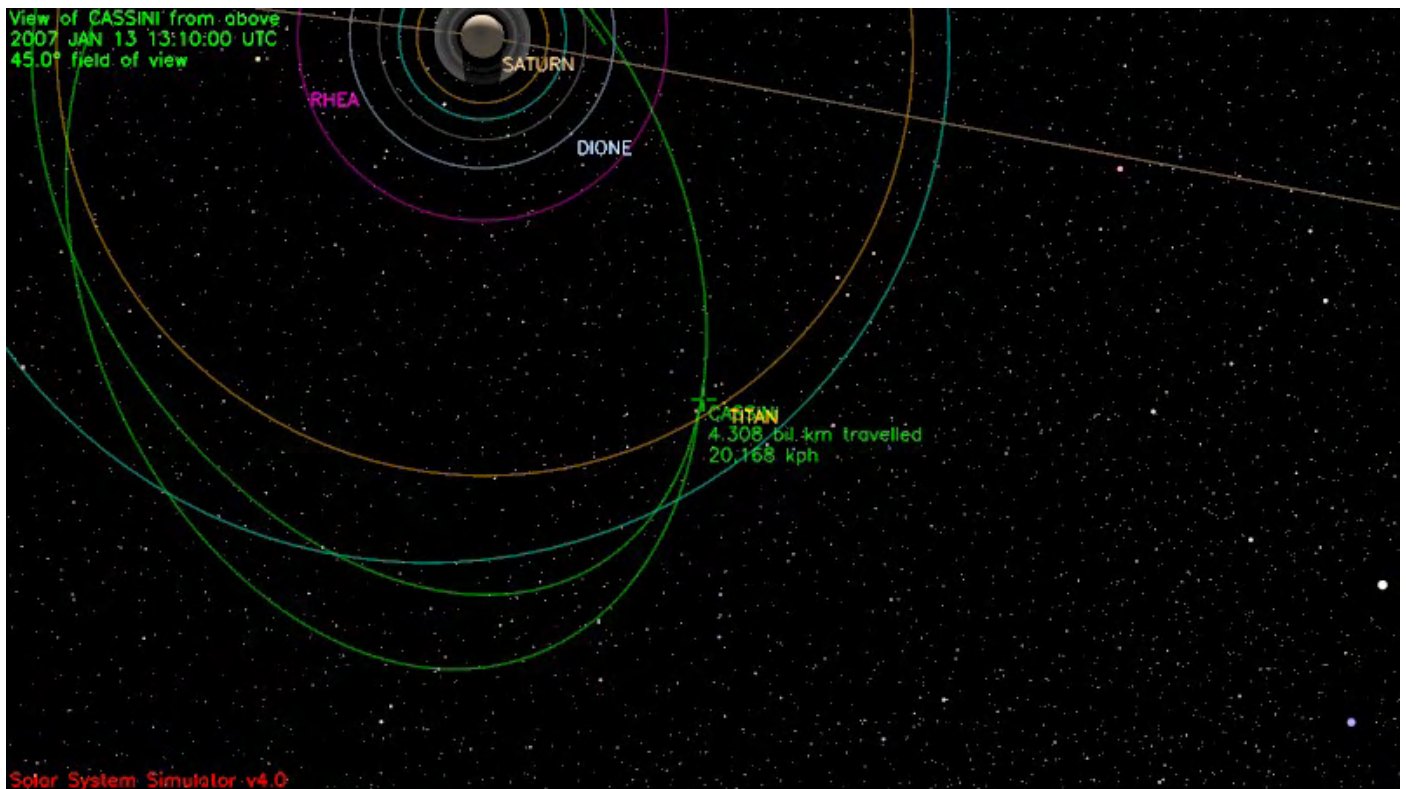
January 2007

Jet Propulsion Laboratory  
California Institute of Technology

## 1.0 OVERVIEW

After just 16-days from its last flyby of Titan, Cassini returns for its twenty-fourth targeted encounter, Titan-23. The closest approach to Titan occurs on Saturday, January 13, at spacecraft time 2007-013T08:38:31 (Dec. 12 at 3:41AM Pacific Time) at an altitude of 1000 kilometers (~621 miles) above the surface and at a speed of 6.0 kilometers per second (13,400 mph). The latitude at closest approach is 31degrees N (over an area known as Aaru), and the encounter occurs on orbit number 37.

This encounter is set up with two maneuvers: an apoapsis maneuver on January 5, and an approach maneuver, scheduled for January 10. This inbound encounter occurs about 3 days before Saturn closest approach.



If Titan were a planet, it would likely stand out as the most important planet in the solar system for humans to explore. Titan, the size of a terrestrial planet, has a dense atmosphere of nitrogen and methane and a surface covered with organic material. It is Titan that is arguably Earth's sister world and the Cassini-Huygens mission considers Titan among its highest priorities.

Although it is far colder and lacks liquid water, the chemical composition of Titan's atmosphere resembles that of early Earth. This, along with the organic chemistry that takes place in Titan's atmosphere, prompts scientists to believe that Titan could provide a laboratory for seeking insight into the origins of life on Earth. Data from the Huygens probe, which touched down on Titan's surface in January 2005, and the Cassini orbiter has shown that many of the processes that occur on Earth also apparently take place on Titan – wind, rain, volcanism, tectonic activity, as well as river channels, and drainage patterns all seem to contribute in shaping Titan's surface. However, at an inhospitable -290 degrees Fahrenheit (-179 degrees Celsius), the chemistry that drives these processes is fundamentally different from Earth's. For example, it is methane that performs many of the same functions on Titan that water does on Earth.

The Huygens probe landed near a bright region now called Adiri, and photographed light hills with dark river beds that empty into a dark plain. It was believed that this dark plain could be a lake or at least a muddy material, but it is now known that Huygens landed in the dark region, and it is solid. Scientists believe it only rains occasionally on Titan, but the rains are extremely fierce when they come.

Only a small number of impact craters have been discovered. This suggests that Titan's surface is constantly being resurfaced by a fluid mixture of water and possibly ammonia, believed to be expelled from volcanoes and hot springs. Some surface features, such as lobate flows, appear to be volcanic structures. Volcanism is now believed to be a significant source of methane in Titan's atmosphere. However, there are no oceans of hydrocarbons as previously hypothesized. Dunes cover large areas of the surface.

The Cassini-Huygens mission, using wavelengths ranging from ultraviolet to radio, is methodically and consistently revealing Titan and answering long-held questions regarding Titan's interior, surface, atmosphere, and the complex interaction with Saturn's magnetosphere. While many pieces of the puzzle are yet to be found, with each Titan flyby comes a new data set that furthers our understanding of this world as we attempt to constrain scenarios for the formation and evolution of Titan and its atmosphere.

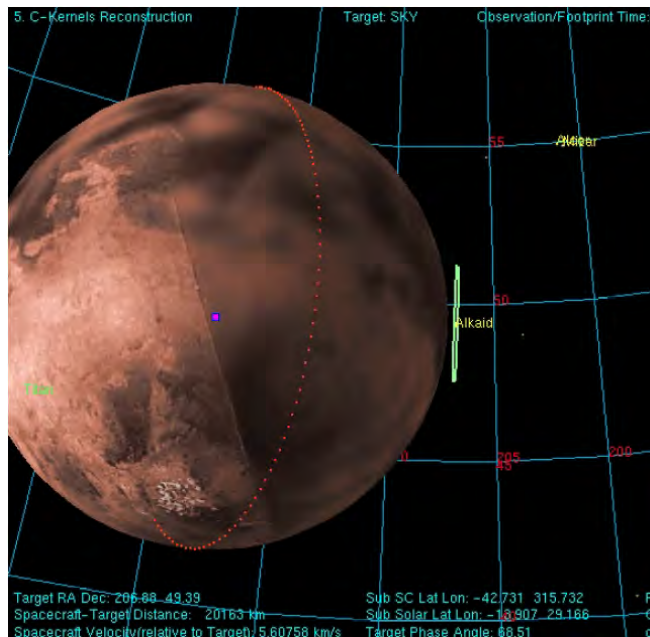
## 1.2 TITAN-23 SCIENCE HIGHLIGHTS

– RADAR: T23 Synthetic Aperture RADAR (SAR) measurement clips Ganesa Macula, which is thought to be a cryovolcanic dome formed when ammonia and water seeped out onto the surface of Titan. (There may be some topographic constraints, certainly in the imaging of northern, as-yet-unseen part of Ganesa).

This flyby also overlaps with TA SAR and TA/T3 altimetry. End of swath is close to mountains seen by VIMS and ‘rim’ of circular feature; T23 also has the highest-latitude altimetry in the mission so far.

- UVIS has an FUV observation, observing the star Eta Ursa Major as it becomes occulted by Titan. See picture to right.

– The ISS outbound and inbound observations will image the surface of Titan and attempt to track atmospheric and surface changes. ISS will also be looking at surface color variations and monitoring limb hazes as well as particle properties, including vertical distributions with resolutions of ~6 km/pix.



– MAPS - Analysis of plasma wake, ions escaping from Titan, and Titan's interaction with Saturn's magnetosphere down to a low altitude (1000 kilometers). INMS specifically will be looking at the atmospheric and ionospheric thermal structure of Titan's atmosphere.

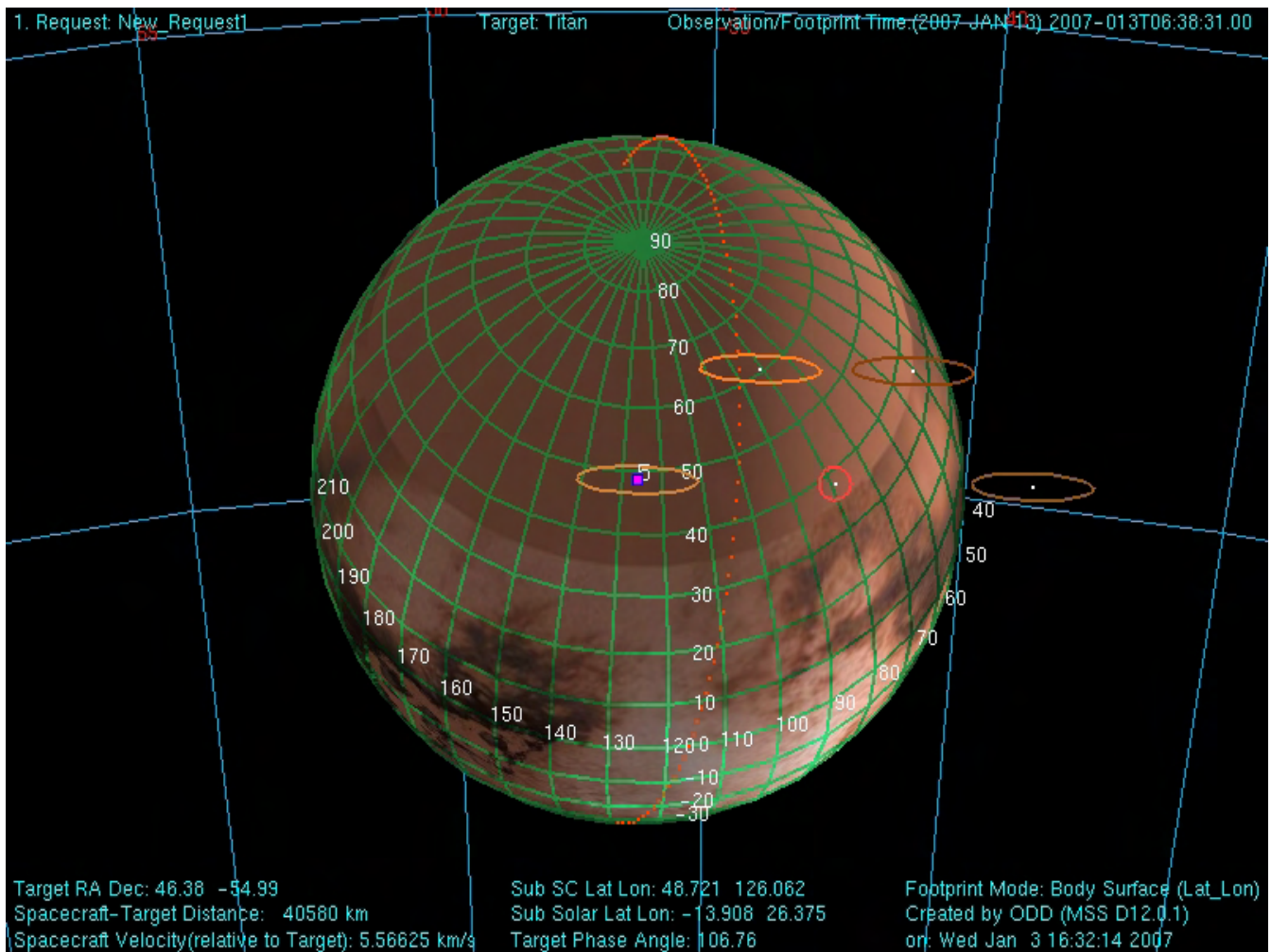
– MIMI will investigate micro-scale and near aspects of the Titan interaction by observing during about one hour period around the Titan encounter. With -Y pointed toward Titan, when within 30 minutes of the targeted flyby, it will also measure Titan exosphere/ magnetosphere interaction.

## 1.3 SAMPLE SNAPSHOTS

Three views of Titan from Cassini before, during, and after closest approach to Titan are shown below. The views are oriented such that the direction towards the top of the page is aligned with the Titan North Pole. The optical fields of view are shown in the first two plots and the remote sensing instrument fields of view are shown in the third, assuming they are pointed towards the center of Titan. The sizes of these fields of view vary as a function of the distance between Cassini and Titan. A key for use in identifying the remote sensing instruments fields of view in the figures is listed at the top of the next page.

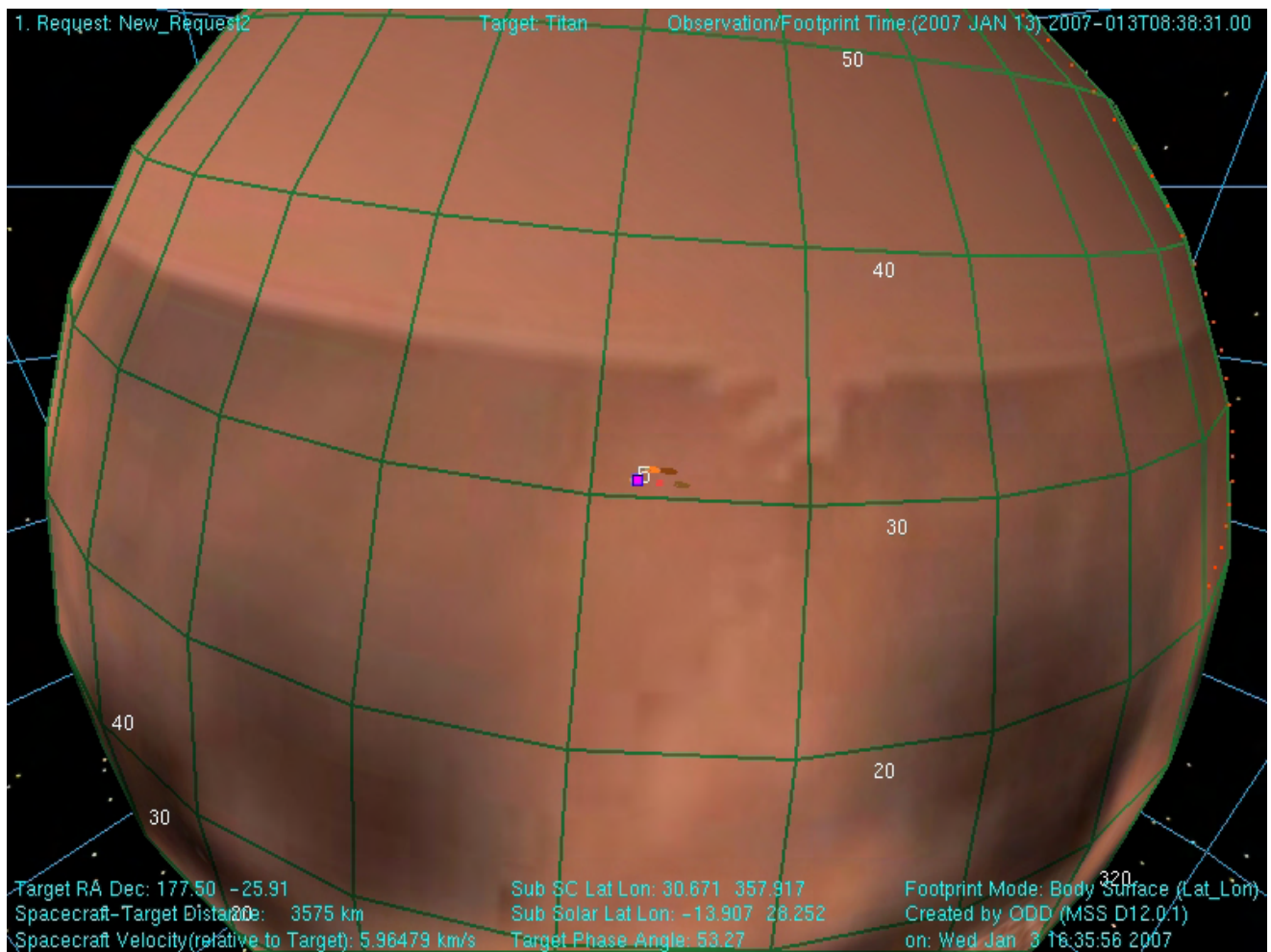
### Key to ORS Instrument Fields of View in Figures

Instrument Field of View	Depiction in Figure
ISS WAC (imaging wide angle camera)	Largest square
VIMS (visual and infrared mapping spectrometer)	Next largest pink square
ISS NAC (imaging narrow angle camera)	Smallest green square
CIRS (composite infrared spectrometer) – Focal Plane 1	Small red circle near ISS_NAC FOV
UVIS (ultraviolet imaging spectrometer)	Vertical purple rectangle centered within largest square

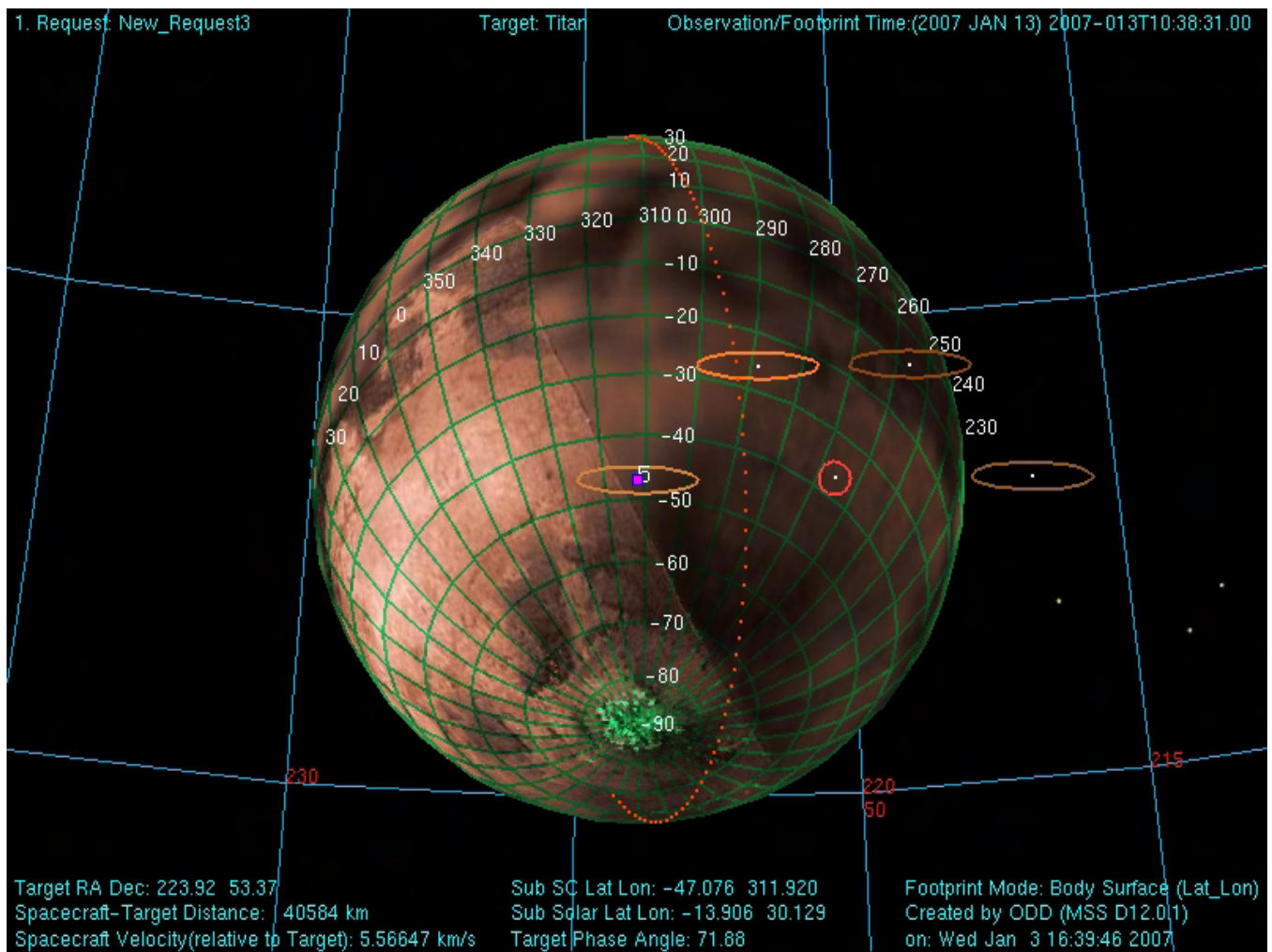


View of Titan from Cassini two hours before Titan-23 closest approach





**View of Titan from Cassini at Titan-23 Closest Approach**



**View of Titan from Cassini two hours after Titan-23 closest approach**

## Timeline and Geometry Table below

### Cassini Titan-23 Timeline - January 2007

Colors: yellow = maneuvers; blue = geometry; pink = T23-related; green = data playbacks

Orbiter UTC	Ground UTC	Pacific Time	Time wrt T23	Activity	Description
365T23:58	Jan 01 01:07	Mon Dec 31 05:07 PM	T23+352d15h	Ascending Ring Plane Crossing	
005T13:50	Jan 05 14:59	Fri Jan 05 06:59 AM	T23-07d19h	Start of Sequence S27	Start of Sequence which contains Titan-23.
010T04:20:00	Jan 10 05:29	Tue Jan 09 09:29 PM	T23-03d04h	OTM #88 Prime	Titan-23 minus 4 day targeting maneuver
011T04:21:00	Jan 11 05:30	Wed Jan 10 09:30 PM	T23-02d04h	OTM #88 Backup	
012T13:34:00	Jan 12 14:43	Fri Jan 12 06:43 AM	T23-19h05m	Start of the TOST Segment	
012T13:34:00	Jan 12 14:43	Fri Jan 12 06:43 AM	T23-19h05m	Turn cameras to Titan	
012T14:04:00	Jan 12 15:13	Fri Jan 12 07:13 AM	T23-18h35m	Deadtime	22 minutes long; used to accommodate changes in flyby time
012T14:23:31	Jan 12 15:32	Fri Jan 12 07:32 AM	T23-18h16m	Titan atmospheric observations	Obtain information on the thermal structure of Titan's stratosphere
012T16:38:31	Jan 12 17:47	Fri Jan 12 09:47 AM	T23-16h01m	Titan limb observations	Search Titans Nightside for Atmospheric Lighting and Auras
012T17:38:31	Jan 12 18:47	Fri Jan 12 10:47 AM	T23-15h01m	Titan atmospheric observations	Obtain information on the thermal structure of Titan's stratosphere
012T19:38:31	Jan 12 20:47	Fri Jan 12 12:47 PM	T23-13h01m	Titan atmospheric observations	Search Titans Nightside Exobase to Dayside Exobase. Also look for trace constituents in Titan's stratosphere.
013T03:38:31	Jan 13 04:47	Fri Jan 12 08:47 PM	T23-05h01m	Radiometry Measurements	Titan Inbound RADAR Radiometry observations
013T07:23:31	Jan 13 08:32	Sat Jan 13 12:32 AM	T23-01h16m	Scatterometry Measurements	Titan Inbound RADAR Scatterometry observations
013T07:46:31	Jan 13 08:55	Sat Jan 13 12:55 AM	T23-00h53m	Transition to Thrusters	Thrusters are needed to compensate for Titan Atmosphere torque and target motion compensation
013T08:08:31	Jan 13 09:17	Sat Jan 13 01:17 AM	T23-00h31m	Titan Inbound RADAR Altimetry observations	Determine altitude of Titan's surface while pointing Nadir.
013T08:23:31	Jan 13 09:32	Sat Jan 13 01:32 AM	T23-00h16m	Low-Res and Hi-Res Synthetic Aperture Radar of Titan's Surface	Determine Titan Surface features. T23 includes a search for lakes on Titan at the High Northern Latitudes.
013T08:39:00	Jan 13 09:48	Sat Jan 13 01:48 AM	T23+00h00m	Titan-23 Flyby Closest Approach Time	Altitude = 1000km (621 miles) , C/A Time = 2007-013T08:38:31, Speed = 6.0 km/s (13,400 mph) , Phase = Lit outbound and 53 degrees at C/A , Local Saturn Time = 1.9 (near midnight) , Magnetospheric Location = Flank in , Subspacecraft Lat, Lon = 31, 358
013T08:58:00	Jan 13 10:07	Sat Jan 13 02:07 AM	T23+00h19m	Descending Ring Plane Crossing	
013T08:45:31	Jan 13 09:54	Sat Jan 13 01:54 AM	T23+00h06m	Titan Outbound RADAR Imaging	RADAR will obtain Synthetic Aperture RADAR (SAR) images of Titan's Surface
013T08:53:31	Jan 13 10:02	Sat Jan 13 02:02 AM	T23+00h14m	Titan outbound RADAR Altimetry Observations	Determine Altitude of Titan Surface while spacecraft is pointing Nadir
013T09:08:31	Jan 13 10:17	Sat Jan 13 02:17 AM	T23+00h29m	Scatterometry Measurements	Titan Outbound RADAR Scatterometry observations
013T09:42:31	Jan 13 10:51	Sat Jan 13 02:51 AM	T23+01h03m	Transition to Reaction Wheels	Wheels are used for greater spacecraft stability.
013T10:19:31	Jan 13 11:28	Sat Jan 13 03:28 AM	T23+01h40m	Radiometry Measurements	Titan Outbound RADAR Radiometry observations
013T13:38:31	Jan 13 14:47	Sat Jan 13 06:47 AM	T23+04h59m	Titan surface observations	Full disk observations for surface and atmospheric mapping
014T02:03:31	Jan 14 03:12	Sat Jan 13 07:12 PM	T23+17h24m	Deadtime	10 minutes long; used to accommodate changes in flyby time
014T04:04:00	Jan 14 05:13	Sat Jan 13 09:13 PM	T23+19h25m	Turn to Earth-Line	
014T04:34:00	Jan 14 05:43	Sat Jan 13 09:43 PM	T23+19h55m	Begin Playback of T23 Data	Madrid 34M Handover to Goldstone 70M
014T13:34:00	Jan 14 14:43	Sun Jan 14 06:43 AM	T23+01d05h	End Playback of T23 Data	
016T13:00	Jan 16 14:09	Tue Jan 16 06:09 AM	T23+03d04h	Saturn Periapse	R = 12.5 Rs, lat = -51 deg, phase = 39 deg

OWLT (mins)	69.26
C/A Time	Sat Jan 13 01:48 AM

## 1.4 FLYBY GEOMETRY

The Flyby Geometry table is not available for Titan-23.



## **1.5      PLAYBACK TIMELINE**

The Playback Timeline is not available for Titan-23